

CLAIMS

What is claimed is:

1. A transfer case comprising:
 - an input shaft;
 - first and second output shafts;
 - a planetary gear assembly including a sun gear driven by said input shaft, a carrier driving said first output shaft, a ring gear, and a planet gear supported by said carrier and meshed with said sun gear and said ring gear, said ring gear interconnected to said sun gear so as to facilitate relative rotation therebetween and movement of said sun gear in response to movement of said ring gear;
 - a range clutch fixed to said ring gear and moveable between a high-range position and a low-range position to establish corresponding high-range and low-range drive connections between said input shaft and said carrier, said range clutch is operable in its high-range position to couple said carrier for rotation with said sun gear and permit rotation of said ring gear, and said range clutch is operable in its low-range position to release said sun gear from coupled engagement with said carrier and brake rotation of said ring gear;
 - a bi-directional overrunning mode clutch operably disposed between said first output shaft and said second output shaft including a mode actuator that is moveable between a first position and a second position to establish corresponding AUTO and LOCK modes, said mode clutch is operable in its AUTO mode to permit relative rotation between said first and second output shafts in a first direction and prevent relative rotation therebetween in a second

direction, and said mode clutch is operable in its LOCK mode to prevent relative rotation between said first and second output shafts in both directions; and

a shift mechanism for controlling movement of said range clutch and said mode actuator.

2. The transfer case of Claim 1 further comprising a first clutch plate fixed to said carrier and a second clutch plate fixed to a stationary member, said range clutch is adapted to engage said second clutch plate when moved to its low-range position and said sun gear is adapted to engage said first clutch plate when said range clutch is moved to its high-range position.

3. The transfer case of Claim 2 further comprising:

a first synchronizer operably disposed between said sun gear and said first clutch plate for inhibiting movement of said range clutch to its high-range position until speed synchronization is established therebetween; and

a second synchronizer operably disposed between said range clutch and said second clutch plate for inhibiting movement of said range sleeve to its low-range position until speed synchronization is established therebetween.

4. The transfer case of Claim 1 further comprising:

a power-operated actuator for controlling movement of said shift mechanism;

a mode selector permitting selection of an on-demand high-range drive mode and a part-time high-range drive mode; and

a controller receiving mode signals from said mode selector and controlling actuation of said power-operator actuator in response to said mode signals.

5. The transfer case of Claim 4 wherein said power-operated actuator includes:

an electric motor having an output rotatably driven in response to control signals from said controller;

a cam rotatively driven by said motor output; and

a mode fork operably interconnected between said mode actuator and said cam for causing movement of said mode actuator in response to rotation of said cam so as to shift said mode clutch between its AUTO and LOCK modes.

6. A transfer case comprising:

an input shaft;

first and second output shafts;

a reduction unit having an input member driven by said input shaft, an output member driving said first output shaft, and a reaction member;

a range clutch operable in a first mode to couple said reaction member for rotation with said input shaft to establish a high-range drive connection between said input shaft and said first output shaft, said range clutch further operable in a second mode to brake rotation of said reaction member to establish a low-range drive connection between said input shaft and said first output shaft;

a bi-directional overrunning mode clutch operable in a first mode to permit relative rotation between said first and second output shafts in a first direction and prevent relative rotation therebetween in a second direction, said mode clutch further operable in a second mode to prevent relative rotation between said first and second output shaft in both directions; and

a shift mechanism for shifting said range clutch between its first and second modes and said mode clutch between its first and second modes.

7. The transfer case of Claim 6 wherein said range clutch includes a first clutch ring coupled to said input shaft, a second clutch ring coupled to a stationary member, and a range sleeve coupled for rotation with said reaction member, said range sleeve moveable between a high-range position and a low-range position, said range sleeve is operable in its high-range position to couple said reaction member to said first clutch ring and establish said high-range drive connection, and said range sleeve is operable in its low-range position to couple said reaction member to said stationary member and establish said low-range drive connection.

8. The transfer case of Claim 7 further comprising:

a first synchronizer operably disposed between said first clutch ring and said range sleeve to inhibit movement of said range sleeve into its high-range position until speed synchronization is established between said input shaft and said reaction member; and

a second synchronizer operably disposed between said second clutch ring and said range sleeve to inhibit movement of said range sleeve into its low-range position until speed synchronization is established between said reaction member and said stationary member.

9. The transfer case of Claim 6 further comprising:
 - a power-operated actuator for controlling movement of said shift mechanism;
 - a mode selector permitting selection of an on-demand high-range drive mode and a part-time high-range drive mode; and
 - a controller receiving mode signals from said mode selector and controlling actuation of said power-operator actuator in response to said mode signals.

10. A transfer case comprising:
 - an input shaft;
 - a first output shaft driven by said input shaft;
 - a second output shaft;
 - a transfer assembly;
 - a bi-directional overrunning mode clutch operably disposed between said transfer assembly and said first output shaft, said mode clutch is operable in an AUTO mode to permit relative rotation between said first output shaft and said transfer assembly in a first direction and prevent relative rotation therebetween in a second direction, and said mode clutch is operable in a LOCK mode to prevent relative rotation between said first output shaft and said transfer assembly in both directions;
 - a disconnect clutch operable in a 2WD mode to release said second output shaft from coupled engagement with said transfer assembly and in a 4WD mode to couple said second output shaft for rotation with said transfer assembly; and
 - a shift mechanism for controlling shifting of said mode clutch between its AUTO and LOCK modes and said disconnect clutch between its 2WD and 4WD modes.

11. The transfer case of Claim 10 wherein said mode clutch includes a mode actuator that is moveable between first and second position to establish said AUTO and LOCK modes, and wherein said disconnect clutch includes a disconnect actuator that is moveable between first and second positions to establish said 2WD and 4WD modes.

12. The transfer case of Claim 11 wherein said shift mechanism is operable to coordinate movement of said mode actuator and said disconnect actuator.

13. The transfer case of Claim 11 wherein an on-demand four-wheel drive mode is established when said mode actuator is in its first position and said disconnect actuator is in its second position.

14. The transfer case of Claim 11 wherein a part-time four-wheel drive mode is established when said mode actuator is in its second position and said disconnect actuator is in its second position.

15. The transfer case of Claim 11 wherein a two-wheel drive mode is established when said mode actuator is in its second position and said disconnect actuator is in its first position.

16. The transfer case of Claim 10 wherein said bi-directional overrunning mode clutch includes a first ring driven by said first output shaft, a second ring, and rollers in rolling engagement with facing surfaces of said first and second rings, said second ring adapted to circumferentially index relative to said first ring to cause said rollers to frictionally couple said second ring to said transfer assembly.

17. The transfer case of Claim 16 wherein said transfer assembly includes a first sprocket rotatably supported on said first output shaft, and a second sprocket that is rotatably supported on said second output shaft and operably driven by said first sprocket, and wherein said second ring of said mode clutch is adapted to releasably engage said first sprocket.

18. The transfer case of Claim 17 wherein said second ring is a split ring defining an actuation slot having first and second end surfaces, and wherein said mode clutch further includes an actuator ring having a lug retained in said actuation slot of said split ring and which is moveable from a central position disengaged from said first and second end surfaces in a first direction into engagement with said first end surface and in a second direction into engagement with said second end surface.

19. The transfer case of Claim 18 wherein said actuator ring has a rim on which a drag band is retained, said drag band having a pair of ends between which a cam block is retained, said cam block having a first segment adapted to engage said ends of said drag band so as to cause said drag band to exert a drag force on said rim of said actuator ring which causes circumferential indexing of said actuator ring in response to relative rotation between said first and second rings, said cam block further includes a second segment adapted to engage said ends of said drag band so as to release said drag force from said actuator ring.

20. The transfer case of Claim 21 wherein said shift mechanism is operable for moving said cam block between a first position whereat its first segment engages said drag band and a second position whereat its second segment engages said drag band.

21. The transfer case of Claim 10 further comprising:

- a power-operated actuator for controlling operation of said shift mechanism;
- a mode selector permitting selection of an on-demand drive mode and a part-time drive mode; and
- a controller receiving mode signals from said mode selector and controlling actuation of said power-operator actuator in response to said mode signals.

22. The transfer case of Claim 21 wherein said power-operated actuator includes:

an electric motor having an output rotatably driven in response to control signals from said controller;

a cam rotatively driven by said motor output;

a first mechanism connecting said disconnect clutch and said cam such that rotation of said cam controls shifting of said disconnect clutch between its 2WD and 4WD modes; and

a second mechanism connecting said mode actuator and said cam such that rotation of said cam controls shifting of said mode clutch between its AUTO and LOCK modes.

23. A transfer case comprising:

an input shaft;

first and second output shafts;

a reduction unit having an input member driven by said input shaft, an output member driving said first output shaft, and a reaction member;

a range clutch operable in a first mode to couple said reaction member for rotation with said input shaft to establish a high-range drive connection between said input shaft and said first output shaft, said range clutch is further operable in a second mode to brake rotation of said member to establish a low-range drive connection between said input shaft and said first output shaft;

a transfer assembly;

a bi-directional overrunning mode clutch operable in a first mode to permit relative rotation between said first output shaft and said transfer assembly in a first direction and prevent relative rotation therebetween in a second direction, said mode clutch further operable in a second mode to prevent relative rotation between said first output shaft and said transfer assembly in both directions;

a disconnect clutch operable in a first mode to couple said second output shaft for rotation with said transfer assembly and in a second mode to release said second output shaft from coupled engagement with said transfer assembly;

and

a shift mechanism for shifting said range clutch between its first and second modes, said mode clutch between its first and second modes, and said disconnect clutch between its first and second modes.

24. The transfer case of Claim 23 wherein said range clutch includes a first clutch ring coupled to said input shaft, a second clutch ring coupled to a stationary member, and a range sleeve coupled for rotation with said reaction member, said range sleeve moveable between a high-range position and a low-range position, said range sleeve is operable in its high-range position to couple said reaction member to said first clutch ring and establish said high-range drive connection, and said range sleeve is operable in its low-range position to couple said reaction member to said stationary member and establish said low-range drive connection.

25. The transfer case of Claim 24 further comprising:

a first synchronizer operably disposed between said first clutch ring and said range sleeve to inhibit movement of said range sleeve into its high-range position until speed synchronization is established between said input shaft and said reaction member; and

a second synchronizer operably disposed between said second clutch ring and said range sleeve to inhibit movement of said range sleeve into its low-range position until speed synchronization is established between said reaction member and said stationary member.

26. The transfer case of Claim 23 further comprising:
 - a power-operated actuator for controlling operation of said shift mechanism;
 - a mode selector permitting selection of at least two different drive modes; and
 - a controller receiving mode signals from said mode selector and controlling actuation of said power-operator actuator in response to said mode signals.

27. The transfer case of Claim 23 wherein said mode clutch includes a mode actuator that is moveable between first and second position to establish corresponding first and second modes, wherein said range clutch includes a range actuator that is moveable between first and second positions to establish corresponding first and second modes; and wherein said disconnect clutch includes a disconnect actuator that is moveable between first and second positions to establish corresponding first and second modes.

28. The transfer case of Claim 27 wherein said shift mechanism is operable to coordinate movement of said mode actuator, said range actuator, and said disconnect actuator.

29. The transfer case of Claim 27 wherein an on-demand four-wheel high-range drive mode is established when said mode actuator is in its first position, said range actuators in its first position, and said disconnect actuator in its first position.

30. The transfer case of Claim 27 wherein a part-time four-wheel high-range mode is established when said mode actuator is in its second position, said range actuator is in its second position, and said disconnect actuator is in its first position.

31. The transfer case of Claim 27 wherein a two-wheel high-range drive mode is established when said mode actuator is in its second position, said range actuator is in its first position, and said disconnect actuator is in its second position.

32. The transfer case of Claim 23 wherein said bi-directional overrunning mode clutch includes a first ring driven by said first output shaft, a second ring, and rollers engaging facing surfaces of said first and second rings, said second ring adapted to circumferentially index relative to said first ring to cause said rollers to frictionally couple said second ring to said transfer assembly.

33. The transfer case of Claim 32 wherein said transfer assembly includes a first sprocket rotatably supported on said first output shaft, and a second sprocket rotatably supported on said second output shaft and operably driven by said first sprocket, wherein said second ring of said mode clutch is adapted to releasably engage said sprocket for selectively transferring drive torque from said first output shaft to said transfer assembly, and wherein said disconnect clutch is operable in its second mode to couple said second sprocket to said second output shaft.

34. The transfer case of Claim 32 wherein said second ring is a split ring defining an actuation slot having first and second end surfaces, and wherein said mode clutch further includes an actuator ring having a lug retained in said actuation slot of said split ring and which is moveable from a central position disengaged from said first and second end surfaces in a first direction into engagement with said first end surface and in a second direction into engagement with said second end surface.